accidentally introduced into Europe. *Diaspis amygdali*, a very destructive coccid, was described by Tryon in 1889 from Australia; already we knew it also from various localities in the Oriental, Palæarctic, Ethiopian, Nearctic and Neotropical regions! Very many other such cases might be cited, showing that there is great need for speedy investigation, before the data regarding the true habitats of these and other organisms become impossible of discovery, owing to the extermination of some species, and the dissemination of others.

T. D. A. Cockerell.

Mesilla, New Mexico, U.S.A., February 12.

Formation of Coral Reefs.

I have read with much interest the description in Nature of the attempt of Prof. Sollas to bore through the rim of the Funafuti Atoll.

I should like to know what ground he has for believing that the soundings obtained by the officers of the ship which conveyed him to the island, support Darwin's theory of the formation of coral atolls; for there does not appear to be any new feature in the section printed with his letter. It is similar to many other sections of atolls in the China Sea and elsewhere, which have been published from time to time by the Hydrographic Department.

As this attempt has failed, it might be well to turn attention to a more accessible part of the Western Pacific.

The Fiji islands are a complete museum of corals, and contain reefs of every sort of formation. Many of these appear to support Darwin's theory. The Lau, or eastern group, has been elevated, and contains some ancient coral reefs many hundred feet above the sea. The island of Naiau is 580 feet high, and has a rim summit of coral enclosing a depression which, if my recollection serves me, is about 200 feet below the top. If Darwin's theory is correct, this ancient atoll must have been first formed by subsidence, and subsequently elevated to its present position. Borings would probably reveal the lost peak not far below the floor of the central depression.

The island of Kambara, 470 feet in height, is of similar formation.

A close geological examination of Naiau or Kambara would, in all probability, end the controversy, for the borings into the base of the island, commencing some hundreds of feet above the sea, but below what I suppose to be an ancient atoll, could be easily undertaken, and ought to prove at once the nature of the foundation upon which the reef rests.

With regard to the concluding paragraph of Prof. Sollas' letter, he has apparently overlooked the fact that a live specimen of reef-building coral (Astræa) has been dredged up from a depth of forty-five fathoms *in the lagoon* of the Tizard bank by Dr. Bassett-Smith, of H.M.S. *Rambler*. This specimen is in the Natural History Museum.

W. Usborne Moore.

8 Western Parade, Southsea, February 25.

Chinese Yeast.

A friend has sent me a few ounces of what he calls Chinese yeast, a white substance which, so I understand, possesses the power of converting rice grains into a soluble substance, which is then allowed to ferment until it is converted into alcohol. Perhaps some of your readers could refer me to a more detailed account of the properties of this yeast. I shall be pleased to send samples for cultivation to anybody who would care to undertake it.

C. E. Stromeyer.

6 Jedburgh Gardens, Glasgow, March 6.

DINOSAURS.[1]

It is only sixty years ago since George Catlin wrote his "North American Indians," and graphically described the vast herds of bison, numbering millions of individuals, travelling for days together across the rolling prairies; yet we have seen these disappear, like the aborigines, and their places usurped by the "cow-boy," and by countless herds of domestic cattle.

If we could only wind the clock of Time still further backwards, and make him disclose, with moving-photographic-vividness, some of those earlier Mesozoic scenes on the American continent, or even in our own little island, for that matter, we should find, not herds of bison, but far other cattle, though some wore horns, and were big and ugly enough in all conscience; yet they were mostly harmless, and herbivorous in diet, but belonging to patterns now entirely obsolete, like the old "brown-bess" of our grandfathers' days, only more so.

And, doubtless, it is due to the extreme rarity of preservation of old land-surfaces, as compared with the far more numerous and abundant records of marine areas which have come down to us, that renders their discovery of such paramount interest to the biologist and geologist. The vast physical changes also which they indicate are, undoubtedly, owing to the immense and unmeasured periods which have intervened, filled only by the slow-music of the sea.

Thus, after parting company with Eocene Mammals, such as *Tinoceras*, we take a plunge in the sea of time, and come again on shore to find that all but the tiniest of Mammals are absent, and the land is peopled by huge herbivorous and somewhat lesser carnivorous Dinosaurs in their stead.

Although this strange reptilian order was discovered so early in this century, it is only within the last thirty years that, thanks to Prof. Huxley, we have been led to understand them; and not till 1881, had we a correct notion even of the skeleton of our own famous *Iguanodon*, though Mantell had commenced to record the discovery of its bones in Sussex in 1825.

One of the most curious points about these mediæval animals is, that they make their earliest appearance in the Triassic period, and were first known in North America some sixty years ago, not by their bones or teeth, but by their footprints. These tracks, discovered so abundantly on the fine-grained, often fissile, sandstones of the Connecticut valley area, were at first attributed to birds, although any birds earlier than the Tertiary period were then unknown.

Yet the genius of Huxley had demonstrated (in 1868) that in the Dinosauria we are dealing with a group of reptiles which most nearly approached the flightless birds, not merely in the weakness and smallness of their fore-limbs, but in the structure of the pelvis, the ilium prolonged forward in front of the acetabulum as well as behind it, and the long rod-like ischium and pubis being all strongly ornithic characters; the head of the femur being set-on at right angles to the shaft of the bone, so that the axis must have been parallel with the median vertical plane of the body, as in birds. The metatarsals were free as in young birds, not anchylosed together as in adult ones; moreover, in *Iguanodon* and some other forms met with, the number of functional digits was three, as seen in the foot of *Dinornis*, and in the great majority of living birds, and the number of the phalanges agrees with that in the II, III and IV toes of the Emeu and Rhea, or any other typical bird's foot. So that there is good reason to conclude that the Connecticut footprints, instead of being those of birds, were certainly the tracks left behind by the *bird*-like Dinosaurs of that period.

From the great difference in size between the fore and hind limbs, Mantell and Leidy concluded that the *Iguanodon*, and some others of its kind, may have supported themselves for a longer or shorter period upon their hind-legs. This conclusion was further confirmed by the discovery made by Mr. S. H. Beckles, F.R.S., of huge three-toed footprints occurring in pairs upon ripple-marked surfaces of Wealden sandstone near Hastings, of such a size, and at such a distance apart, as to lead to the conclusion that they were undoubtedly made by *Iguanodon*. Mr. Beckles' discovery has since been confirmed by the observations of Louis Dollo upon the

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[1] "The Dinosaurs of North America." By Othniel Charles Marsh. Extract from the Sixteenth Annual Report of the United States Geological Survey, 1894–95. C. D. Walcott, Director. Imperial 8vo. Pp. 133 + 414. Pl. ii + lxxxv. (Washington, 1896.)

Bernissart *Iguanodon* in the Brussels Museum, a cast of which may now be seen set up in the British Museum of Natural History, Cromwell Road.

A few detached reptilian remains from the Trias of America had been made known by Dr. Leidy and Prof. Hitchcock as early as 1854 and 1856; but in 1884, Prof. O. C. Marsh obtained for the Yale University Museum a large part of a dinosaur about 8 feet in length, and, later on, a smaller but most complete example, named by him *Anchisaurus colurus*, of which five individuals were discovered, all being of carnivorous type, and the oldest known of the division Theropoda. Marsh feels confident that these and other (perhaps herbivorous) forms were the makers of the bipedal tracks met with in such numbers in the Trias of America, for of the presence of birds at this period we have no evidence whatever.

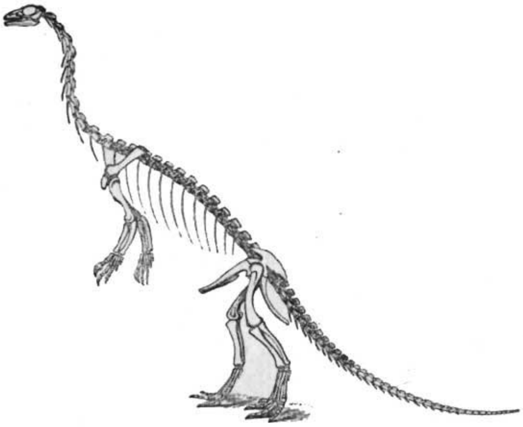


FIG. 1.—Restoration of *Anchisaurus colurus*, Marsh ($\frac{1}{24}$ nat. size). Triassic, Connecticut. The reptile which is believed to have made the bird-like bipedal footprints upon the Connecticut sandstones.

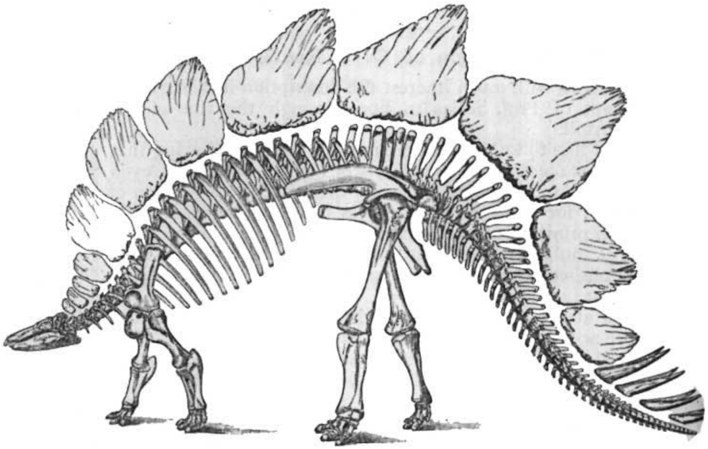


FIG. 3.—Restoration of *Stegosaurus ungulatus*, Marsh ($\frac{1}{80}$ nat. size), a hoofed and armoured herbivorous Dinosaur from the Jurassic of Wyoming. (The size of the brain of *Stegosaurus* was only $\frac{1}{100}$ that of a young alligator's, if the weight of the entire animal is considered).

Passing from the Triassic sandstones to the Jurassic period, we have in the various deposits from the Lias of Charmouth, with its herbivorous dinosaur, *Scelidosaurus Harrisoni*, to the Inferior and Great Oolite, with its *Megalosaurus*, its *Omosaurus* and *Cetiosaurus* in this country, represented by *Atlantosaurus*, *Ceratosaurus*, *Stegosaurus*, *Brontosaurus*, *Camptosaurus*, *Laosaurus*, and many other well-known forms, discovered and described by Marsh, from the Jurassic beds of Colorado and Wyoming Territory, U.S.A.

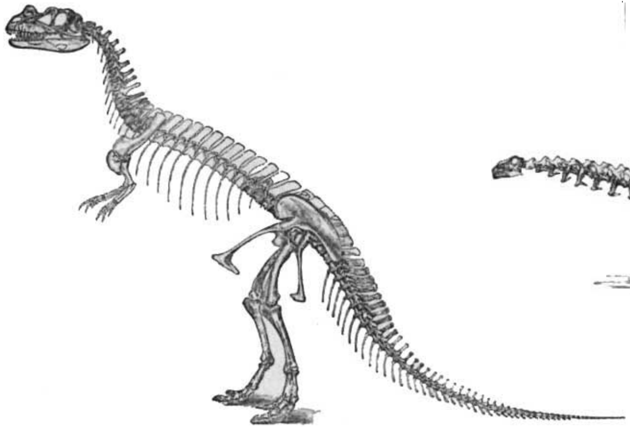


FIG. 2.—Restoration of a carnivorous Dinosaur, *Ceratosaurus nasicornis*, Marsh ($\frac{1}{30}$ nat. size). Jurassic, Colorado.

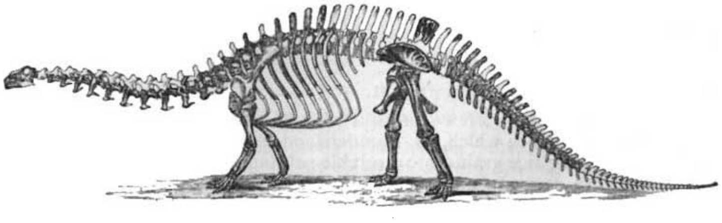


FIG. 4.—Restoration of *Brontosaurus excelsus*, Marsh ($\frac{1}{180}$ nat. size, length 60 feet), a huge unarmed herbivorous Dinosaur from the Jurassic of Wyoming. (Estimated when living to have weighed 20 tons! A stupid slow-moving reptile, probably existing upon aquatic or other succulent vegetation.)

We have, in fact, in the Jurassic period, entered upon "the age of Dinosaurs"; and if, as seems now to be the general conclusion arrived at concerning the age of our own Wealden formation—by Seward, from an examination of the plants; by A. Smith Woodward, from the mammals and fishes; by Marsh, from the reptiles—this deposit is also of Oolitic age, and thus another old-land-area must be relegated to the Jurassic, rather than to the Cretaceous epoch, and we may look upon *Iguanodon* as an Oolitic type.

Indeed, if the Iguanodon had not been contemporary with the Megalosaur in the Jurassic period, we should have had repeated over again the mournful story of the poor lion, in the Roman amphitheatre, who hadn't any Christian to eat; for the carnivorous Megalosaur of the Oolites would, in that case, have often gone supperless to bed for want of his Iguanodon.

Admitting the strong palæontological evidence which has been brought forward (*Geol. Mag.* 1896, pp. 8 and 69) in favour of the Jurassic age of the Wealden beds; nevertheless the age of Dinosaurs did not terminate until the close of the Cretaceous epoch, for Huxley described (*Geol. Mag.* 1867, p. 65) a small armed dinosaur (*Acanthopholis horridus*) from the Chalk-marl of Folkestone, and Seeley has determined another (*Orthomerus Dolloi*) from the Maestricht Chalk (*Q.J.G.S.* 1883, p. 248); whilst Marsh has obtained from the Cretaceous beds of the Laramie, in Wyoming, most complete evidence of the entire skeleton of *Claosaurus annectens*, one of a family of herbivorous dinosaurs, in which the cheek-teeth are very numerous and arranged in vertical series, not fewer than 150 being present, whilst the anterior portion of the jaws are narrower and edentulous, but produced in front in a rather wider predentary bone, which was, in all probability, covered with a horny mandible fitted to meet the strong beak above. Save in the more slender head, and the small and feeble fore-limbs, *Claosaurus* greatly reminds one of *Iguanodon*.

In support of the erect position in which so many of Marsh's animals are represented, it may be well to mention that *Claosaurus* has "in the median dorsal region, between the ribs and the neural spines, numerous rodlike ossified tendons, which increase in number in the sacral region and along the base of the tail, and then gradually diminish in number and size, ending at about the thirty-fifth caudal. These ossified tendons are well shown in the restoration (Fig. 6), and are of much interest." Similar ossified tendons are seen in *Iguanodon*, and they doubtless served to give attachment to the great dorsal muscles which supported the vertebral column when the animal assumed an upright attitude, or when it used its immense and powerful tail as an oar in swimming across a stream.

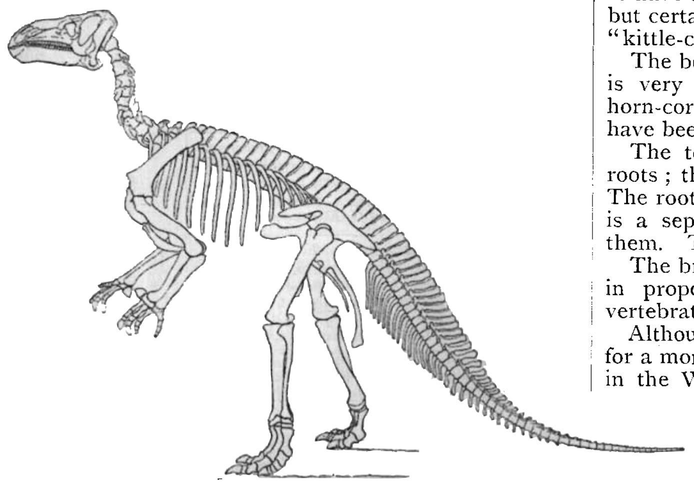


FIG. 5.—Restoration of *Iguanodon Bernissartensis*, Boul. ($\frac{1}{80}$ nat. size). An herbivorous dinosaur from the Wealden (Upper Jurassic?) Bernissart, Belgium.

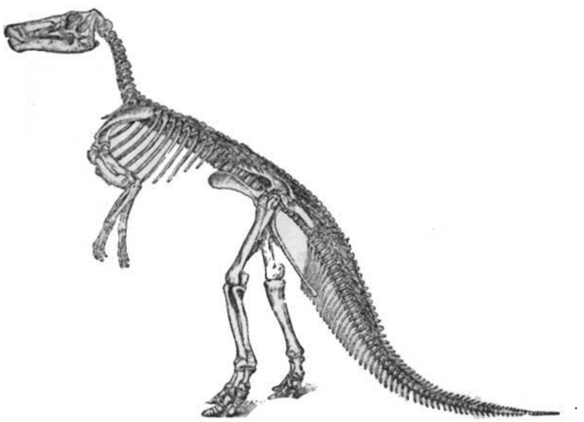


FIG. 6.—Restoration of *Claosaurus annectens*, Marsh, an herbivorous Dinosaur ($\frac{1}{80}$ nat. size). Cretaceous, Wyoming.

Another, and possibly the most singular, as well as one of the latest of Prof. Marsh's pets, is the huge *Triceratops prorsus*, one of the quadrupedal dinosaurs, with a skull armed with three horns, two of which were nearly a yard long, and having a bony frill, like an immense Elizabethan ruff, four feet broad, attached to the back of its occiput, the cranium and frill being 6 feet in length from the nose to the hinder border of the bony ruffle.

But skulls of *Triceratops horridus* have been obtained by Marsh, measuring from 7 to 8 feet in length.

Its horns, when found broken off from the skull, were so like the bony horn-cores of some bovine ruminant, as to have been suspected to belong to some very ancient ox; but certainly such three-horned beasts would have been "kittle-cattle" to yoke, or to plough with!

The beak-like edentulous character of the mandibles is very striking, and from the vascular surface of the horn-cores and bony frill, these too, when living, must have been sheathed in a strong horny external covering.

The teeth are very remarkable, having two distinct roots; this is true both of the upper and the lower series. The roots are placed transversely in the jaw, and there is a separate cavity more or less distinct for each of them. They form a single series only in each jaw.

The brain of *Triceratops* appears to have been smaller in proportion to the entire skull than in any known vertebrate.

Although we have nothing in this country which can for a moment compare, in magnitude, with the vast areas in the Western Territories of the United States, often covered to an enormous thickness by great lacustrine deposits of Tertiary, Cretaceous, Jurassic, and Triassic age, full of evidences of old land conditions, yet in our limited island we can show evidence probably of ten successive land-stages from the Wealden to the Trias, marked by Mammals or Dinosaurs, by Pterodactyles, and by insects, by plants and carbonaceous shales or coal-seams; so that throughout the lower Secondary series, at least, we can lay down buoys to mark the spots where the old land was situated, though of its actual extent we know but little.

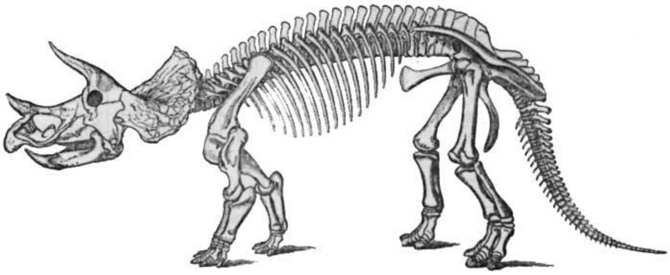
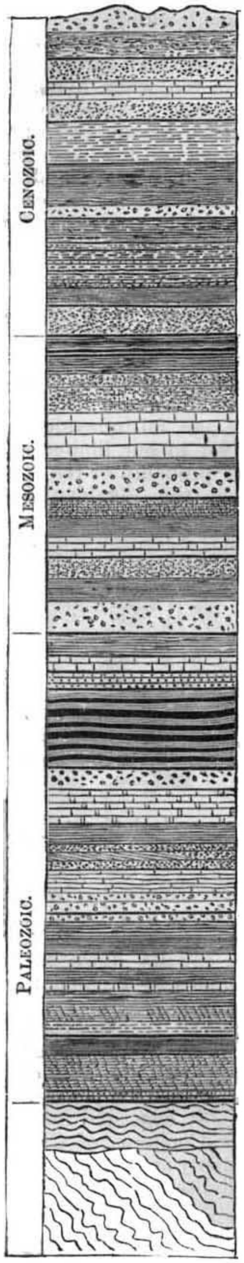


FIG. 7.—Restoration of *Triceratops prorsus*, Marsh ($\frac{1}{80}$ nat. size). Cretaceous, Wyoming. (Length in life about 25 feet, height 10 feet.)

What, we may well ask, were the peculiar conditions of life in the Mesozoic period, which brought about the evolution and continuance through this long æon of such a remarkable land fauna? The associated Jurassic flora may help to solve this query. It consisted largely of Araucarias, *Thujites*, and other Coniferæ, of Cycadeæ, and Palms, of Tree-ferns and many species of Filicinæ, of lesser growth, of giant Equisetums, of liverworts and club-mosses, and some herbaceous and aquatic plants; but, so far as our records tell, no grasses had as yet made their appearance. It is, therefore, certainly reasonable to conclude that most of the herbivorous dinosaurs must have subsisted, almost wholly, by browsing upon the leaves, shoots, and young branches of arboreal vegetation (as did the giant ground-sloths of later Tertiary times in South America), although some may perhaps have fed upon aquatic plants.

This habit doubtless tended to develop their frequent bipedal mode of progression amidst the tall and luxuriant vegetation along the river-banks where they pastured. It also enabled them the better to espy the approach of their enemies, the light-leaping *Hallopus* and *Compso-*

gnathus, and the fierce *Allosaurus* and *Megalosaurus*. These beasts of prey assumed the erect position, not only to observe, but also to rapidly overtake and leap upon their quarry; and it may be, too, that they were able to deceive them by their superficial resemblance to the vegetarians, who were literally taken in by them.



Recent. Quaternary.			Tapir, Peccary, Bison. *Bos, Equus, Tapirus, Dicotyles, Megatherium, Mylodon.*	
Tertiary	Pliocene.	Equus Beds.	*Equus, Tapirus, Elephas.*	
		Pliohippus Beds.	*Pliohippus, Tapiravus, Mastodon, Procamelus, Aceratherium, Bos, Morotherium, Platygonus.*	
	Miocene.	Miohippus Beds.	*Miohippus, Diceratherium, Thinohyus, Protoceras.*	
		Oreodon Beds.	*Oreodon, Eporeodon, Hyænodon, Moropus, Ictops, Hyracodon, Agriochœrus, Colodon, Leptochœrus.*	
		Brontotherium Beds	*Brontotherium, Brontops, Allops, Titanops, Titanotherium, Mesohippus, Ancodus, Entelodon.*	
	Eocene.	Diplacodon Beds.	*Diplacodon, Epihippus, Amynodon, Eomeryx.*	
		Dinoceras Beds.	*Dinoceras, Tinoceras, Uintatherium, Palæosyops, Orohippus, Hyrachyus, Colonoceras, Homacodon.*	
		Heliobatis Beds.	*Heliobatis, Amia, Lepidosteus, Asineops, Clupea.*	
		Coryphodon Beds.	*Coryphodon, Eohippus, Eohyus, Hyracops, Parahyus* Lemurs, Ungulates, Tillodonts, Rodents, Serpents.	
Cretaceous.		Laramie Series, or Ceratops Beds.	*Ceratops, Triceratops, Claosaurus, Ornithomimus.* Mammals, *Cimolomys, Dipriodon, Selenacodon, Nanomyops, Stagodon.* Birds, *Cimolopteryx.*	Known Range of Dinosaurs in Time.
		Fox Hills Group.		
		Colorado Series, or Pteranodon Beds.	Birds with Teeth, *Hesperornis, Ichthyornis, Apatornis.* Mosasaurs, *Edestosaurus, Lestosaurus, Tylosaurus.* Pterodactyls, *Pteranodon.* Plesiosaurs, Turtles.	
		Dakota Group.		
Jurassic.		Atlantosaurus Beds Baptanodon Beds. Hallopus Beds.	Dinosaurs, *Brontosaurus, Morosaurus, Diplodocus. Stegosaurus, Camptosaurus, Ceratosaurus.* Mammals, *Dryolestes, Stylacodon, Tinodon, Ctenacodon.*	
Triassic.		Otozoum, or Conn. River, Beds.	First Mammals, *Dromatherium.* First Dinosaurs. *Anchisaurus. Ammosaurus, Bathygnathus, Clepsysaurus.* Many footprints. Crocodiles, *Belodon.* Fishes, *Catopterus, Ischypterus, Ptycholepis.*	
Permian.		Nothodon Beds.	Reptiles, *Nothodon, Eryops, Sphenacodon.*	
Carboniferous		Coal Measures, or Eosaurus Beds.	First Reptiles (?) *Eosaurus.* Amphibians, *Baphetes, Dendrerpeton, Hylonomus, Pelion.* Footprints, *Anthracopus, Allopus, Baropus, Dromopus, Hylopus, Limnopus, Nasopus.*	
		Subcarboniferous, or Sauropus Beds.	First known Amphibians (Labyrinthodonts). Footprints, *Sauropus, Thenaropus.*	
Devonian.		Dinichthys Beds. Lower Devonian	*Dinichthys, Acanthodes, Bothriolepis, Chirolepis, Cladodus, Dipterus, Titanichthys.*	
Silurian.		Upper Silurian. Lower Silurian.	First known Fishes.	
Cambrian.		Primordial.	No Vertebrates known.	
Archæan.		Huronian.		
		Laurentian.		

FIG. 3.—Table of British strata, with their North American equivalents, and a list of the vertebrate fossils which are found in them in the United States; drawn up by O. C. Marsh.

We cannot, in so brief a notice, do justice to the labours of Prof. Marsh in this interesting field of inquiry; but those who care to take up this latest volume on Dinosaurs, will find it well repay the perusal. His studies of the brains of these ancient reptiles is alone deserving most careful consideration. The comparison of the brain of *Stegosaurus ungulatus*, with the enormously larger neural cavity in the sacrum, has led to the statement that Marsh had discovered an animal with its brain in its tail! "This reminds me"—I was asking the late Captain Speke on his return, in 1864, from Somaliland, what he thought of the Somalis, to which he replied, "They are a splendid race of men, only, unfortunately, their brain is developed at the wrong end of their backbone."

The present work by Prof. Marsh is, after all, but a summary of more than fifteen years' labour in the field and in the museum, and may, it is hoped, be followed by even a larger monograph. Nevertheless this volume is a storehouse of facts and figures (there are eighty-four plates!), and will prove of the greatest value to the palæontologist and the biologist.